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Timber Harvesting Increases Deer and Elk Use of a Mixed Conifer Forest

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Timber harvesting in a mixed conifer forest in Arizona resulted in an increase in a mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) use index, while the index remained unchanged in an adjacent uncut area. Herbage production increased 50 pounds per acre, and aspen (*Populus tremuloides*) increased by 321 stems per acre after the timber harvest. Aspen stems and leaves, because of their nutritional value, are important deer and elk foods in the mixed conifer type.

Keywords: *Odocoileus hemionus*, *Cervus canadensis*, timber harvesting, mixed conifer, wildlife habitat.

Mixed conifer vegetation supports many wildlife species (approximately 90 birds and mammals in Arizona) because it is a vegetatively diverse zone between the higher spruce-fir and lower ponderosa pine forests. It is especially important as summer and fall range for mule deer and elk that use the natural openings and clearcut areas (Reynolds 1966). In Oregon, elk use doubled in openings cut in mixed conifer forest (Edgerton 1972). In the same study, large selectively cut areas had lower deer use than uncut stands. There are no comparable research results for the mixed conifer type in the Southwest except for aspen stands.

Aspen stands are generally associated with mixed conifer and provide large amounts of herbaceous vegetation for grazing animals. Deer use these stands more than the adjacent forest, but there is no difference in elk use (Reynolds 1969).

Precipitation on high-elevation forested watersheds provides runoff for domestic and agricultural use in lower areas. Recent studies have shown that the mixed conifer vegetation type has a higher water yield

than other types in the Southwest (Ffolliott and Thorud 1975), and additional water can be obtained from the type by reducing tree overstory (Rich and Thompson 1974). Thus timber harvesting to produce more water can be expected to increase. Mixed conifer vegetation in Arizona, Colorado, and New Mexico covers about 2 million acres; Arizona's portion is between 250,000 and 300,000 acres (Jones 1974).

Timber harvesting changes the attributes of habitat, both structurally and spatially. These changes are sudden, and resident animals are immediately presented with new environmental conditions that could have either positive or negative effects. Managers need to know how wildlife responds to habitat changes from timber harvesting so they can recommend alternative types of cutting to enhance or preserve habitat for food and cover. This Note reports the results of a 7-year study (1969 to 1975) to determine the effects of timber harvesting in Southwestern mixed conifer on mule deer and elk use.

Study Areas

The study areas, one 504 acres (treatment) and the second 328 acres (control), were located on the Apache National Forest approximately 50 miles south of Springerville, Arizona. Relatively steep slopes and

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sharp, narrow drainages are characteristic of both watersheds. The main aspects are southeast and northwest. Elevations range from 8,800 to 9,300 feet. Precipitation records indicate about 30 inches a year. April, May, and June are the dry months, receiving 6 percent of the total precipitation. The growing season (July to September) gets 30 percent of the annual precipitation.

Mixed conifer vegetation in the study areas includes a relatively large number of tree species: Engelmann spruce (*Picea engelmannii*), blue spruce (*Picea pungens*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), corkbark fir (*Abies lasiocarpa*), ponderosa pine (*Pinus ponderosa*), southwestern white pine (*Pinus strobiformis*), and quaking aspen. Browse species include aspen, boxleaf (*Pachistima myrsinites*), snowberry (*Symphoricarpos palmeri*), and oak (*Quercus gambelii*). Arizona fescue (*Festuca arizonica*), mountain muhly (*Muhlenbergia montana*), and nodding brome (*Bromus anomalus*) are the characteristic grasses. Common forbs present are lupine (*Lupinus argenteus*), western yarrow (*Achillea lanulosa*), and cinquefoil (*Potentilla hippiana*). A general description of the mixed conifer type and factors influencing its silviculture has been published in a status-of-knowledge paper by Jones (1974).

Two harvesting methods were used: selection cutting and overstory removal. In the selection area, emphasis was on removing single trees and small groups, and salvaging defective trees. In the overstory removal area, trees were harvested down to a 10-inch diameter limit, although some trees larger than 10 inches were left, especially along roads and meadows. Occasionally, large trees were also left as perches and feeding sites for songbirds.

Methods

The timber inventory design was a systematic point sample using a Basal Area Factor prism of 25. There were 182 points in the watershed to be harvested and 127 points in the control. Timber was removed in 1972. Aspen stems were counted on 0.003-acre circular plots at each inventory point once before (3 years) and once after (2 years) the timber harvest. On these same plots, grasses and forbs were clipped on a subplot of 9.6 square feet. Aspen stems and leaves were collected in July and October to determine protein, calcium, and phosphorus content.

Deer and elk fecal pellets were counted in both watersheds once a year during the first week in September. The plots used were the same as for aspen stem counts. Pellets were counted in September before falling aspen leaves made them difficult to find. Pellet counts were converted to deer and elk use indexes by dividing groups per acre by the defecation rate (13 groups per day).

Timber Harvest Effects

In terms of tree density, the overstory removal (302 acres) was a more severe treatment than selection (114 acres). Basal area was reduced only from 197 to 135 square feet per acre by selective cutting. The remaining basal area was contained in 152 trees per acre over 7 inches d.b.h. Overstory removal, in contrast, reduced basal area from 179 to 29 square feet per acre. Although this was a drastic reduction (84 percent), it was not uniform. Within the area there remained 22 patches of trees from $\frac{1}{3}$ to $3\frac{1}{2}$ acres. Thus deer and elk using the overstory removal area would be 750 feet or less from cover.

Preharvest deer use was similar on both watersheds. Deer use gradually increased in the cut watershed from 1973 to 1975, while use stayed the same for 2 years and then declined in 1975 in the uncut area. Elk use of both watersheds was low throughout the study period, but increased slightly in the treated area after the timber harvest. Index of days of use per acre, determined by dividing pellet groups per acre by the defecation rate (13 groups per day), for deer and elk in the cut and uncut watershed was as follows:

	Deer use		Elk use	
	Cut	Uncut	Cut	Uncut
1969	3.6	4.2	0.2	0.2
1970	1.4	1.4	.4	0
1971	.7	1.2	.2	.4
1973	2.8	2.2	.8	.6
1974	3.5	2.2	1.4	.8
1975	4.2	1.6	1.8	.8

No count was made in 1972 because timber harvest was in progress.

Numbers of aspen stems increased on the cut watershed from 494 to 815 per acre 2 years after the timber harvest. Aspen stems and leaves in October rank from good to excellent for protein, phosphorus, and calcium:

	Stems			Leaves		
	-	-	-	Live (Percent)	Fallen	-
Protein:						
July	5.2			12.0	—	
October	9.8			12.6	4.0	
Phosphorus:						
July	.22			.40	—	
October	.29			.57	.20	
Calcium:						
July	.63			.77	—	
October	.68			.73	.17	

These rankings were determined from ranges of nutrient percentages (Urness 1973). Herbage estimates made 3 years before and 2 years after the

timber harvest show an increase of about 50 pounds per acre:

	1969 (Before)	1974 (After)	Change
Forbs	84	122	+38
Grasses	16	29	+13
Total	100	151	+51

Conclusions and Management Implications

The use index indicates beneficial effects for deer following a timber harvest in an Arizona mixed conifer forest. These findings follow the same trend as reported for a ponderosa pine forest (Patton 1974). Evidently, the same factors of food, cover, and diversity resulting from timber harvesting in ponderosa pine are also at work in the mixed conifer. Elk also responded to the timber harvest, but use was less than for deer.

An increase in the use index does not necessarily mean there was an increase in animal numbers. Changes brought about by timber harvesting could entice deer and elk to move from the surrounding uncut forest. If the changes are beneficial, however, animal numbers should increase over time. Results from this study add more weight to the premise that timber harvesting is beneficial to deer and elk as long as sufficient protective cover remains.

When recommending timber harvesting for habitat improvement, managers must be concerned with **how much vegetation to leave for cover**, not just **how much timber to remove to stimulate forage production**. The balance between the two factors must be determined before proper management guidelines can be established.

Since aspen is an important source of energy for deer and elk, every effort should be made to regenerate old aspen stands to make twigs and leaves available for food. Timber harvesting is one way to get aspen to sprout. More sprouting probably can be achieved, however, by the judicious use of fire after the timber harvest (Patton and Avant 1970).

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